Delivering large doses of medication quickly and efficiently while minimizing the side effects of skin burns or blisters

The drug solution is quite dilute, thus an abundance of water molecules is present. To maintain current flow between the treatment and return electrodes, an electrochemical reaction must take place at each electrode, converting the electron flow from the solid conductors (leadwire, snap and conductive carbon layer) to a flow of ions across the solution in the reservoir pad. These reactions are:

Negative electrode: \( 2e^- + 2H_2O \rightarrow 2OH^- + H_2 \)

Positive electrode: \( 2H_2O \rightarrow 4H^+ + O_2 + 4e^- \)

Electrons are produced at the positive electrode and consumed at the negative electrode; this completes the electrochemical circuit. Also produced by this reaction are \( OH^- \) ions (basic pH) at the negative electrode and \( H^+ \) ions (acidic pH) at the positive electrode. It is accepted that the presence of these extraneous ions is very undesirable during an iontophoretic treatment. They compete with the treatment ions of the same charge for the available driving current and can negatively affect delivery rates of the drug. 1,2

The excess \( OH^- \) or \( H^+ \) also can significantly raise or lower the pH of the overall solution causing skin burns and blisters, especially at higher current levels and longer treatment durations. With higher current levels and longer treatment time, more of the “problem” ions are created.

The observation of pH shifts toward the acid and alkaline side under the anode (+) and cathode (-) during iontophoresis has been well documented and dates back to the 1930s in the literature.3 It is one of the principal reasons unbuffered iontophoresis electrode systems are limited in terms of the current density (mA/surface area) and total dosage (mA·min) that can be safely applied. It is the primary reason unbuffered systems cannot deliver ionized medications as efficiently as the Chattanooga Group Iontophoresis Electrode System (in terms of µg of medication delivered/mA·min if treatment).

The patented Buffered Iontophoresis Electrode System from Chattanooga Group employs a two-way buffering agent that is incorporated uniformly throughout the reservoir pad of each Chattanooga Group drug delivery electrode. The buffering agent is a mixture of two forms of immobile ion exchange resin, which very effectively binds and neutralizes the undesirable \( OH^- \) or \( H^+ \) ions as soon as they are produced. The Chattanooga Group iontophoresis buffering agent works equally well whether the treatment protocol calls for negative or positive polarity.

The buffering of the undesirable ions allows the drug or treatment ions to be driven more efficiently at greater delivery rates because they are no longer competing to carry the current with the smaller, more mobile \( OH^- \) and \( H^+ \) ions. The current is being carried by the treatment ions, not the “problem” ions, across the skin and into the tissue.

The buffering of the undesirable basic \( OH^- \) or acidic \( H^+ \) ions also serves to greatly reduce the common side effect of iontophoresis with unbuffered electrodes — skin burns and blisters. Researchers have found solution pH levels to rise as high as 12 (caustic) and fall as low as 2 (acidic) after a 20 minute, 4.0 mA treatment with an unbuffered iontophoresis electrode filled with normal saline solution. The same tests, using Chattanooga Ionto™ Ultra Buffered Iontophoresis Electrodes resulted in final pH levels in the 5 to 6 (neutral) range.6
The only safe approach for unbuffered systems is to use lower current settings and shorter treatment times. Then, of course, a still smaller amount of medication is delivered to the treatment site. 1,4,5

**The patented Chattanooga Ionto Ultra Buffered Iontophoresis Electrode allows for a high treatment dosages (up to 80 mA·min), at high current levels (up to 4.0 mA), with high delivery efficiency, while reducing the risk of electrochemical (pH) burns or blisters.**

References used in this Chattanooga Ionto Essentials flyer include:

6. Data on file, Encore Medical, L.P.